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Product Brochure

ElectroMagnetic Field Measurements

EMF Option 444

Anritsu's ElectroMagnetic Field (EMF) Measurements are designed to measure radiation compliance with various national standards for personal safety set by governmental regulatory authorities. Many countries have mandated EMF safety testing in areas where cellular or other high power transmission antennas are located. The EMF option is primarily targeted to both cellular operators and government regulators. Additionally, contractors and small service companies perform building inspections and field surveys to monitor radiation exposure intensities in areas situated near transmission antennas.

Anritsu's EMF Measurements are designed to be easy to use, while providing the user with numerous automated features which will enable them to do their job quickly and more efficiently. ElectroMagnetic field measurements (EMF, Option 444) are available on the following Anritsu Spectrum Master™, Cell Master™ and LMR Master™ products: MS2711E, MS2712E, MS2713E, MS2720T, MT8212E, MT8213E and S412E. Firmware version 1.56 or later is required for the MS2711E/12E/13E and MT8212E/13E. For the MS2720T and S412E firmware version 1.12 or later is required.

EMF Option (444) provides the capability to measure electromagnetic field radiation when used in conjunction with an Anritsu isotropic antenna. Automated measurements can be taken using user-definable time intervals.

EMF Measurements Key Features and Benefits

- Limit lines that are user-settable at various power levels across the spectrum
- Limits can be saved for recall at a later time
- Axis dwell time is user-settable (time that each axis [X, Y, and Z] measures radiation before switching to next axis)
- Pass/Fail indicators on screen for immediate feedback on test results
- Automatic save feature for easy storage of measurement results to internal memory (auto-logging) or USB stick
- Results provided for maximum, minimum, average of all measurements conducted
- Clear display of measurement status, measurement time, number of measurements taken, and most other user settings
- Measurement time is user-configurable
- Pre-amp standard for measurements of low-level signals (optional for MS2711E)

Available field strength units include the following: (S412E Supports Spectrum Analyzer and LTE Modes ONLY)

- Spectrum Analyzer Mode: dBm/m^2, dBmV/m, dBuV/m, V/m, W/m^2, dBW/m^2, A/m, dBA/m, W/cm^2
- LTE and TD-LTE Mode: dBm/m^2, V/m, W/m^2
- W-CDMA Mode: dBm/m^2, V/m, W/m^2, % of Limit (V/m), % of Limit (W/m^2)

For wideband radiation measurements, the EMF option operates in Spectrum Analyzer mode. Total radiation from all sources can be measured over the frequency band desired. The EMF option will also conduct radiation measurements of demodulated signals in specific frequency bands. In this way, measurements can be extrapolated assuming a fully-loaded traffic channel in order to present a worst-case analysis.
Option 444 will work with demodulated signals of the following types: (S412E Supports LTE ONLY)

- W-CDMA
- LTE
- TD-LTE

If the user desires to measure EMF with a demodulated signal, the appropriate demodulation option also will need to be purchased. Additionally, Option 9 (demodulation) will need to be purchased if not offered as standard with the Spectrum Analyzer being used.

Customers with Spectrum Analyzers purchased previously may upgrade their units with the EMF Option 444. If EMF demodulation measurements are required, the appropriate demodulation option will also need to be purchased and installed.

Isotropic Antenna

In order to conduct EMF measurements, an Anritsu isotropic antenna is required. Anritsu offers three isotropic antennas covering a frequency range from 9 kHz to 6 GHz. These antennas along with their corresponding frequency ranges are shown below.

- 9 kHz to 300 MHz H-Field Isotropic Antenna (Anritsu part number: 2000-1800-R)
- 30 MHz to 3 GHz E-Field Isotropic Antenna (Anritsu part number: 2000-1792-R)
- 700 MHz to 6 GHz E-Field Isotropic Antenna (Anritsu part number: 2000-1791-R)

Each antenna contains a tri-axis sensor with an integrated RF switch device, microcontroller and memory. Each of the three sensors is situated orthogonally inside the antenna housing to transmit and receive a spherical radiation pattern. In this way, all radiation at the antenna's geographical position is measured, regardless of direction of arrival.

The RF switch, microcontroller, and memory inside the antenna are controlled by firmware in the Spectrum Analyzer via a USB cable. The microcontroller operates the RF switch, controlling which probe is active. Once all three probes are switched, a composite RMS calculation is made. The memory inside the antenna is used to store parameters associated with that particular antenna. This includes serial number, date of calibration, antenna frequency range, and calibration factors.

Each isotropic antenna is calibrated over its entire frequency range. The antenna factors are stored in the antenna's memory and automatically downloaded into the Spectrum Analyzer once the antenna USB cable is inserted.

H-Field Isotropic Antenna 9 kHz to 300 MHz
2000-1800-R

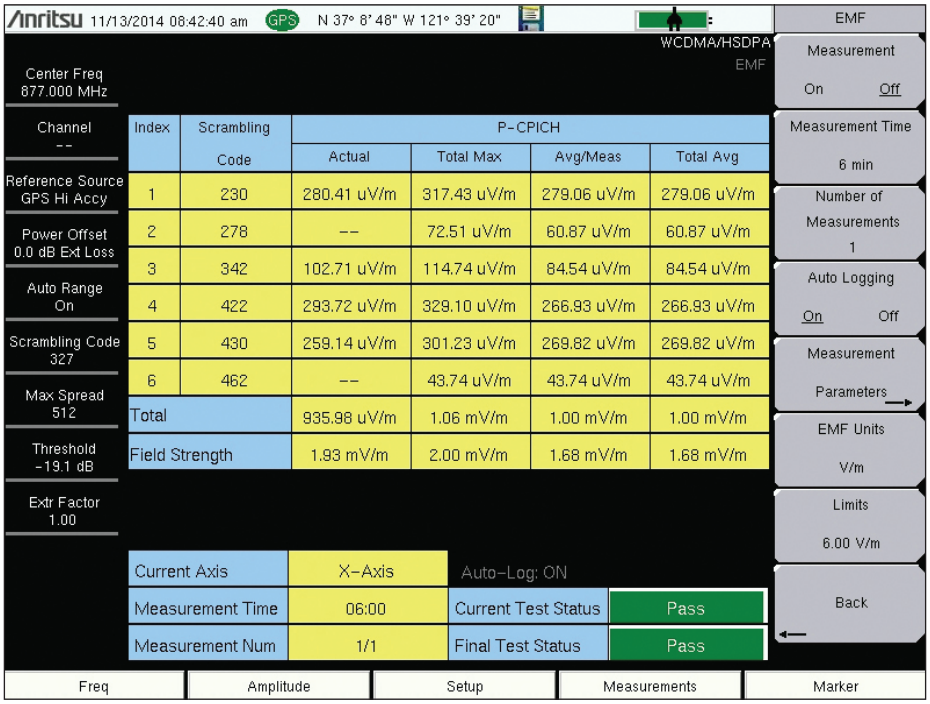
E-Field Isotropic Antenna 30 MHz to 3 GHz
2000-1792-R

E-Field Isotropic Antenna 700 MHz to 6 GHz
2000-1791-R

EMF Measurements on Demodulated Signals

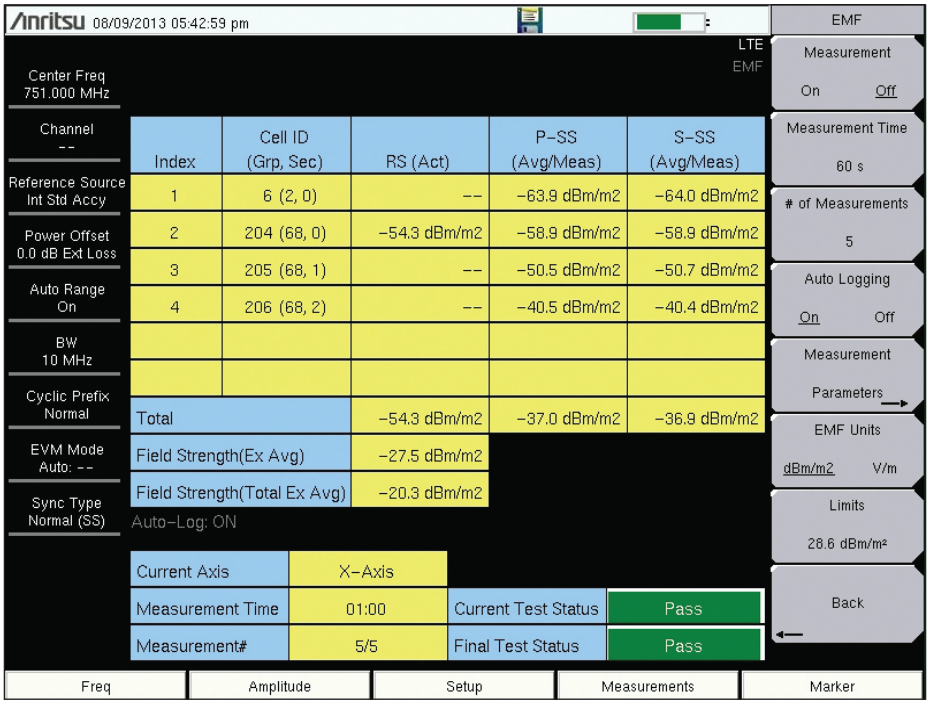
Users may purchase the EMF option in order to make radiation power measurements in Spectrum Analyzer mode. These are power measurements for either narrowband or wideband field strength measurements across the frequency range of the Spectrum Analyzer and isotropic antenna being used. Additionally, EMF testing can be conducted on demodulated signals in various cellular channels. This includes the LTE, TD-LTE, and W-CDMA standards.

To measure demodulated W-CDMA signals, Option 35 is required for the MS2712E/13E and MT8212E/13E platforms. For MS2720T, Option 81 is required for W-CDMA. Option 9 is also required for the MS2712E/13E and MS2720T platforms for W-CDMA demodulation capability. The field strength of the pilot channel (P-CPICH) is measured for all such signals present. Results are then displayed for each individual scrambling code as well as for total power levels for all measurements combined. Additionally, the analog signal strength across the channel is measured and displayed for comparison. In order to present a “worst case” result, extrapolation factors can be automatically calculated and displayed where a fully loaded traffic channel is assumed.



Sample Display of W-CDMA Measurement

For LTE and TD-LTE, options 546 and 556 respectively are required for the MS2712E/13E and MT8212E/13E platforms. Option 83 is required for either LTE or TD-LTE on the MS2720T platform. Option 9 is also required for the MS2712E/13E and MS2720T platforms for LTE or TD-LTE demodulation capability. For LTE only, options 31 and 546 are required for the S412E. Primary Synchronization Signals (P-SS), Secondary Synchronization Signals (S-SS), and Reference Signals (RS) are measured and displayed based on each Cell ID received. In addition, the total radiation field resulting from all cell site signals combined is calculated and displayed. The analog signal strength across the channel is also measured and displayed for comparison. In order to present a "worst case" result, extrapolation factors can be automatically calculated and displayed where a fully loaded traffic channel is assumed. See the picture below for a sample display of an LTE EMF measurement. The display for the TD-LTE EMF measurement is identical.



Sample Display of EMF LTE Measurement

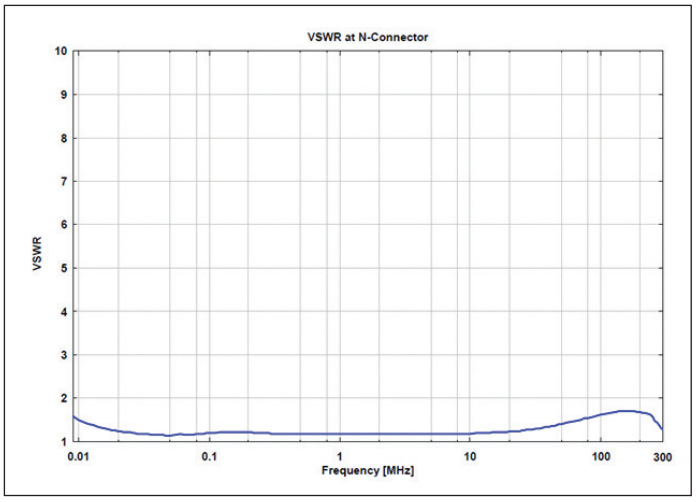
Isotropic Antenna Specifications

The 2000-1800-R isotropic antenna is a tri-axis H-Field sensor with an integrated RF switch. The RF switch is controlled by the analyzer via a USB port.

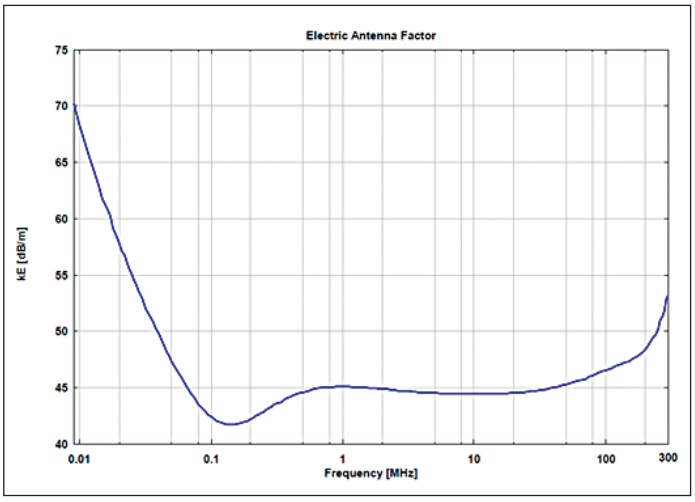
Each antenna comes with a calibration certificate and supporting test data.

Electrical Characteristics (2000-1800-R)

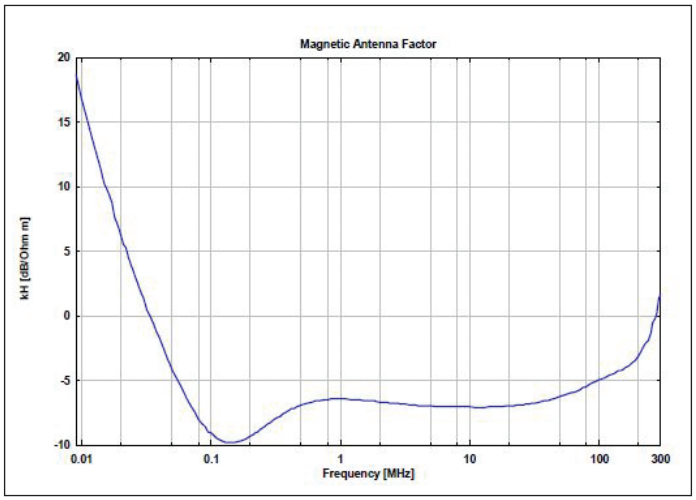
2000-1800-R	H-Field sensor
Sensor Type	Three Axis sensor with scanned axes
Frequency Range	9 kHz to 300 MHz
1 dB Compression Point at Output	118 dBµV typical
Decoupling of the axis	> 20 dB typical
VSWR	< 1.5 (20 kHz - 50 MHz) typical
RF Connector	N-Connector Male, 50 Ω
Supply and Control	USB



VSWR (typical)



Antenna Factors (typical)



Magnetic Antenna Factor (typical)

Mechanical Characteristics (2000-1800-R)

Color	Body: B-39047 “Light Grey”
	Handle: “Black”
Weight	850 g
Environmental Conditions	–10 °C to +50 °C, IP54
Mechanical compliancy	Operating: 7M3 (IEC 60721-3)
Dimensions	550 mm x 146 mm

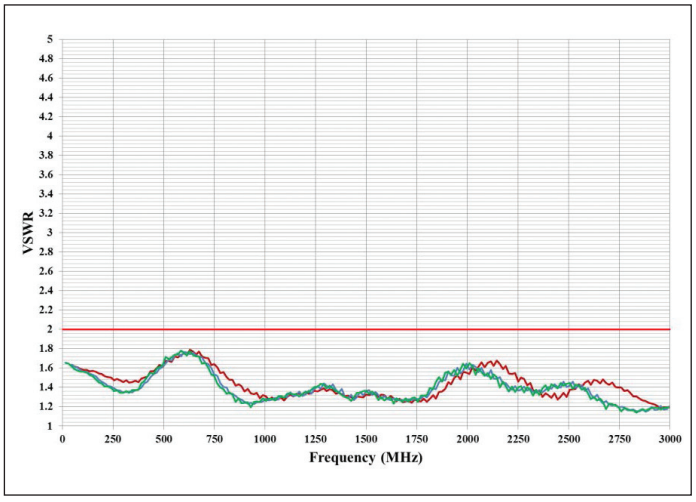
Isotropic Antenna Specifications

The 2000-1792-R isotropic antenna is a tri-axis E-Field sensor with an integrated RF switch. The RF switch is controlled by the analyzer via a USB port.

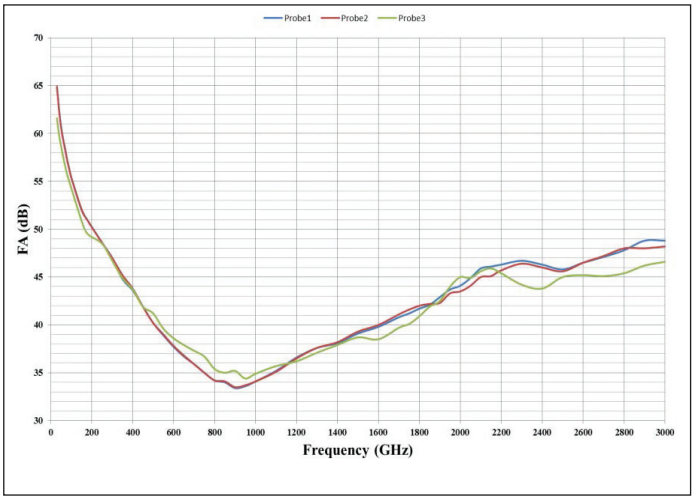
Each antenna comes with a calibration certificate and supporting test data.

Electrical Characteristics (2000-1792-R)

2000-1792-R	E-Field sensor
Sensor Type	Three Axis sensor with scanned axes
Frequency Range	30 MHz to 3 GHz
Typical 3D Isotropy	< ± 1.5 dB (300 MHz to 1 GHz) < ± 2.3 dB (1 GHz to 3 GHz)
Dynamic Range (with 1 kHz RBW)	0.1 mV/m to 200 V/m (Typ) 25 µV at 900 MHz 35 µV at 1800 MHz 50 µV at 3000 MHz
Maximum Field Strength	500 V/m (destruction limit)
Switching Time	< 10 µs
RF Connector	N-Connector Male, 50 Ω
Supply and Control	USB



VSWR (typical)



Antenna Factors (typical)

Mechanical Characteristics (2000-1792-R)

Radome Material	ABS	
Color	Body: B-39047 “Light Grey”	
	Handle: B-39042 “Dark Grey”	
Weight	800 g	
Climatic compliancy	Operating: 7K3 (IEC 60721-3)	
Mechanical compliancy	Operating: 7M3 (IEC 60792-3)	
Temperature Range (operating)	–25 °C, +70 °C	
Humidity	100 % at +40 °C for up to 96 hours	
Dimensions	Maximum Length	Maximum Width
	450 mm ± 5 mm (with connector)	150 mm ± 1 mm

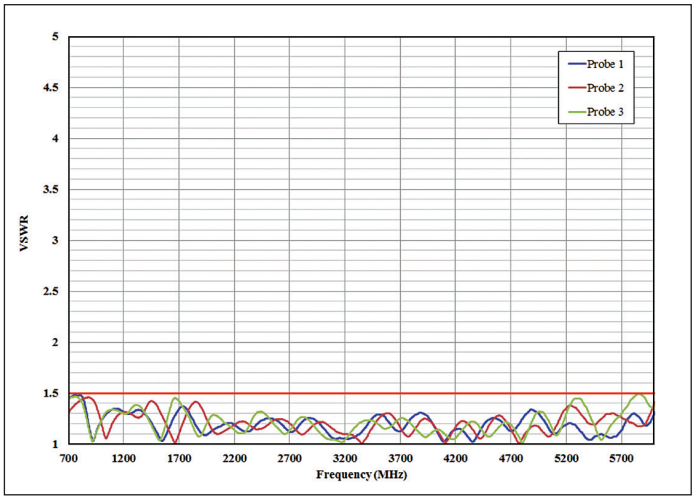
Isotropic Antenna Specifications

The 2000-1791-R isotropic antenna is a tri-axis E-Field sensor with an integrated RF switch. The RF switch is controlled by the analyzer via a USB port.

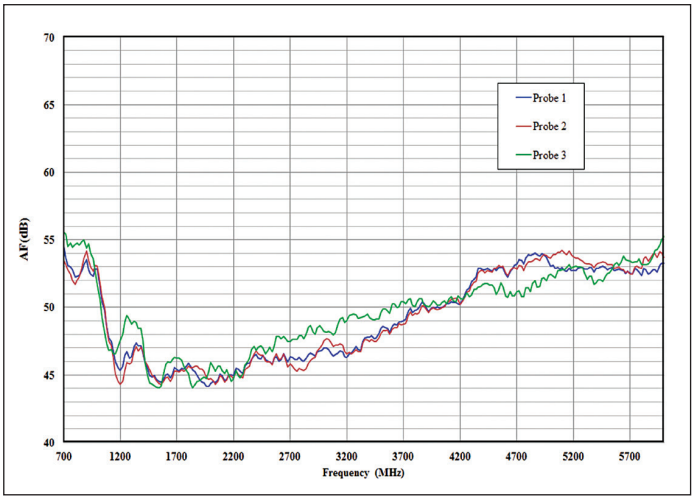
Each antenna comes with a calibration certificate and supporting test data.

Electrical Characteristics (2000-1791-R)

2000-1791-R	E-Field sensor
Sensor Type	Three Axis sensor with scanned axes
Frequency Range	700 MHz to 6 GHz
Typical 3D Isotropy	≤ ± 2 dB (0.7 GHz to 2 GHz) ≤ ± 2.5 dB (2 GHz to 3.6 GHz) ≤ ± 3.5 dB (3.6 GHz to 6 GHz)
Dynamic Range (with 1 kHz RBW)	0.2 mV/m to 200 V/m (typical)
Maximum Field Strength	500 V/m (destruction limit)
Switching Time	< 10 µs
RF Connector	N-Connector Male, 50 Ω
Supply and Control	USB



VSWR (typical)



Antenna Factors (typical)

Mechanical Characteristics (2000-1791-R)

Radome Material	ABS	
Color	Body: B-39047 “Light Grey”	
	Handle: B-39042 “Dark Grey”	
Weight	450 g	
Climatic compliancy	Operating: 7K3 (IEC 60721-3)	
Mechanical compliancy	Operating: 7M3 (IEC 60792-3)	
Temperature Range (operating)	–25 °C, +70 °C	
Humidity	100 % at +40 °C for up to 96 hours	
Dimensions	Maximum Length	Maximum Width
	320 mm ± 5 mm (with connector)	87 mm ± 1 mm

Required Instrument Options and Accessories

Part Number	Description
MS2711E-0444	EMF Option 444 for MS2711E
MS2712E-0444	EMF Option 444 for MS2712E
MS2713E-0444	EMF Option 444 for MS2713E
MS2720T-0444	EMF Option 444 for MS2720T
MT8212E-0444	EMF Option 444 for MT8212E
MT8213E-0444	EMF Option 444 for MT8213E
S412E-0444	EMF Option 444 for S412E
2000-1800-R	Isotropic Antenna, 9 kHz to 300 MHz, N Connector (male), 50 Ω
2000-1792-R	Isotropic Antenna, 30 MHz to 3 GHz, N Connector (male), 50 Ω
2000-1791-R	Isotropic Antenna, 700 MHz to 6 GHz N Connector (male), 50 Ω
200-1528-R	GPS Antenna, SMA(m) with 15 ft cable

Related Instrument Options

Part Number	Description
MS2712E-0009	20 MHz Bandwidth Demodulation for MS2712E
MS2713E-0009	20 MHz Bandwidth Demodulation for MS2713E
MS2720T-0009	20 MHz Bandwidth Demodulation for MS2720T
MS2712E-0035	W-CDMA OTA Measurements for MS2712E*
MS2713E-0035	W-CDMA OTA Measurements for MS2713E*
MS2720T-0881	W-CDMA OTA Measurements for MS2720T*
MT8212E-0035	W-CDMA OTA Measurements for MT8212E
MT8213E-0035	W-CDMA OTA Measurements for MT8213E
MS2712E-0546	LTE OTA Measurements for MS2712E*
MS2713E-0546	LTE OTA Measurements for MS2713E*
MS2720T-0883	LTE OTA Measurements for MS2720T*
MT8212E-0546	LTE OTA Measurements for MT8212E
MT8213E-0546	LTE OTA Measurements for MT8213E
MS2712E-0556	TD-LTE OTA Measurements for MS2712E*
MS2713E-0556	TD-LTE OTA Measurements for MS2713E*
MS2720T-0883	TD-LTE OTA Measurements for MS2720T*
MT8212E-0556	TD-LTE OTA Measurements for MT8212E
MT8213E-0556	TD-LTE OTA Measurements for MT8213E
S412E-0006	6 GHz Coverage for S412E Spectrum Analyzer
S412E-0031	GPS Receiver for S412E (Requires suitable GPS Antenna)
S412E-0546	LTE OTA Measurement for S412E (Requires Option 31)
	*requires Option 9, 20 MHz Bandwidth Demodulation

Cell Master MT8213E
with 2000-1800-R
Isotropic Antenna

Spectrum Master MS2712E
with 2000-1792-R
Isotropic Antenna

Spectrum Master MS2720T
with 2000-1791-R
Isotropic Antenna

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